

# PICKUP MECHANISM FOR MICROWORKPIECE

## BACKGROUND OF THE INVENTION

### Field of the Invention

5 The invention generally relates to a mechanism for picking up tiny workpiece, and more particularly relates to a mechanism for supplying, orientating and separating micro components in advance of further fabrication or assembly process.

### Related Art

10 Researchers and engineers started developing integrated circuits by 1960. After developments in these years, minimized electronic products have been widely used in homes and give a revolution to the industry.

15 Now, engineers are further incorporating conventional machining techniques and semiconductor fabrication methods, and developing micromachine technologies, such as microelectromechanical system (MEMS), lithography electrofoaming micromolding (LIGA) and micromaching. The micromachine technologies minimize the sizes of mechanical devices. They are supposed to further revolutionize the industry just like the semiconductor technologies had.

20 Before assembling a micromachine, the microworkpieces or micro components have to be individually picked up and handled. The techniques at least include supplying, orientating and separating the components. Though some prior arts, such as that disclosed in US Patent Nos. 6,218,762; 6,220,550 and 6,255,758, provide means for transferring micro components, they do not provide the techniques required for a continuous process, such as supplying, orientating and separating the micro components.

25 To assemble a practical micromachine, it requires a pickup mechanism that can first supply the micro components, then arrange the components in order and separate them one by one for further assembly process.

## SUMMARY OF THE INVENTION

The invention is therefore to provide a pickup mechanism for microworkpiece through which the workpieces are supplied, orientated and separated in a continuous process for further assembly procedure.

5 To achieve the aforesaid object, a pickup mechanism according to the present invention includes a microworkpiece supplying unit, a microworkpiece orientation unit and a microworkpiece separation unit. The microworkpiece orientation unit connects with the microworkpiece supplying unit and the microworkpiece separation unit. The micro components are supplied by the supplying unit, then orientated by the orientation unit.  
10 Those components orientated in a specific direction are led to the separation unit and separated for a following working device to process. Therefore, the pickup mechanism of the invention provides a continuous supplying, orientation and separation of the micro components for further assembly or fabrication processes.

15 Further scope of applicability of the invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

## 20 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more fully understood from the detailed description given hereinbelow. However, this description is for purposes of illustration only, and thus is not limitative of the invention, wherein:

25 FIG. 1 is a block diagram showing the composition of a pickup mechanism according to the invention;

FIGS. 2A to 2D are embodiments of supplying unit applied in the invention;

FIGS. 3A to 3D are embodiments of orientation unit applied in the invention;

FIGS. 4A to 4C are functional views of a transferrer of an orientation unit applied in the invention;

FIGS. 5A to 5E are functional views of another transferrer of an orientation unit applied in the invention; and

FIGS. 6A to 6D are embodiments of separation unit applied in the invention.

### DETAILED DESCRIPTION OF THE INVENTION

As shown in FIG. 1, a pickup mechanism according to the present invention includes a microworkpiece supplying unit 10, a microworkpiece orientation unit 20 and a microworkpiece separation unit 30 for supplying, orientating and separating the micro components 1 (as shown in FIG. 2A) for a following working unit 40 to process. The microworkpiece orientation unit 20 connects with the microworkpiece supplying unit 10 and the microworkpiece separation unit 30. The micro components 1 are supplied by the supplying unit 10, then orientated by the orientation unit 20. Those components orientated in a specific direction are led to the separation unit 30 and separated for the following working device 40 to process.

The microworkpiece supplying unit 10 is used to supply the micro components 1 to the microworkpiece orientation unit 20. Several kinds of devices can be applied. For example, the situation of supplying units 10 having at least one reciprocating microactuator, swinging microactuator, piezoelectric microactuator or pneumatic actuator will be described below.

As shown in FIG. 2A, a reciprocating microactuator 110 includes a supplying element 111 and an accumulator 112. The supplying element 111 supplies micro components 1 to the accumulator 112. The accumulator 112 receives the micro components 1 when the supplying element 111 moves up and down relatively to the accumulator 112.

As shown in FIG. 2B, a swinging microactuator 120 includes a supplying element 121 and an accumulator 122. The supplying element 121 supplies micro components 1 to the accumulator 122. The accumulator 122 receives the micro components 1 when the supplying element 121 swings relatively to the accumulator 122.

5 As shown in FIG. 2C, a piezoelectric microactuator 130 includes a supplying element 131 for supplying the micro component 1; a plane 134 for receiving the micro components 1 from the supplying element 131; vibrators 133, 133' connected respectively to the supplying element 131 and the plane 134 for shaking the two; and an accumulator 132 for receiving the micro components 1 from the plane 134. The supplying element 131  
10 supplies the micro components 1 to the plane 134 and further moves them to the accumulator 132 by vibration of the vibrators 133 and 133'.

As shown in FIG. 2D, a pneumatic microactuator 140 includes a supplying element 141 and an accumulator 142. The supplying element 141 supplies micro components 1 to the accumulator 142. The accumulator 142 sucks the micro components 1 in when  
15 airflow coming from bottom of the supplying element 141 blows up the micro components 1.

The microworkpiece orientation unit 20 is connected to the microworkpiece supplying unit 10 and used to arrange the micro components 1 into specific direction for the microworkpiece separation unit 30 to operate. Several embodiments of microworkpiece  
20 orientation unit 20 will be described below.

As shown in FIGS. 3A, 4A, 4B and 4C, a microworkpiece orientation unit 20 includes some stoppers 21, 22 for selecting micro components 1 of specific direction, and a transferrer 23 for moving the micro components 1. The stoppers 21, 22 are used to expel those micro components 1 that are not in the desired direction. The transferrer 23 includes  
25 a serial of microactuators 231 and a transport belt 232 for transferring the micro components 1 to the microworkpiece separation unit 30. The serial of microactuators 231 located under the transport belt 232 reciprocate orderly so as to make the transport belt 232 move in a wave motion and push the micro components 1 along the transport belt 232.

Another embodiment of transferrer 23 is illustrated in FIGS. 5A to 5E. The transferrer 23 includes pairs of microactuators 231, 231' and a micro transport belt 232. Each microactuator 231 or 231' will swing to a specific direction upon being electrically powered, and release to another direction upon power-off. Therefore, the first microactuators 231 first release upwards, as shown in FIG. 5A, then the second microactuators 231' are powered to swing downwards, as shown in FIG. 5B. Further, the first microactuators 231 are powered to swing downwards, as shown in FIG. 5C, and the second microactuators 231' release upwards, as shown in FIG. 5D. Again, the first microactuators 231 release upwards, as shown in FIG. 5E, and so the microactuators 231 and 231' repeat. The movement of the microactuators 231, 231' make the micro transport belt 232 moves so that the micro components 1 will move along with the micro transport belt 232. Other methods for actuating the transferrer 23, such as motor-powered transport belt, can also be applied.

When the micro transport belt 232 transfers the orientated micro components 1 to the separation unit 30, the stopper 21, 22 of the microworkpiece orientation unit 20 expel those micro components 1 that are not in the correct direction and only pass the micro components 1 of the correct direction. As shown in FIGS. 3B, 3C, 3D, the stoppers 21, 22 of FIG. 3A are replaced by a stopper 21 and a cutoff 24 or just by cutoffs 24 for expelling the micro components 1 of wrong direction.

The microworkpiece separation unit 30 is connected to the microworkpiece orientation unit 20 and used to separate the micro components 1 into specific path for being assembled or fabricated. Several embodiments of microworkpiece separation unit 30 will be described below.

As shown in FIG. 6A, a microworkpiece separation unit 30 includes a separator 31, a reservoir 32 and a transferrer 33. The reservoir 32 stores the orientated micro components 1 provided by the microworkpiece orientation unit 20. The transferrer 33 transports the micro components 1 that have been separated. The separator 31 will separate the micro components 1 one by one (or several ones a time) from the reservoir 32 to the transferrer 33.

As shown in the drawing, when the separator 31 moves toward the reservoir 32, a micro component 1 is pushed into the transferrer 33, and will be moved to an unshown working device 40 for a following process.

5 As shown in FIG. 6B, a microworkpiece separation unit 30 includes a separator 31 for separating two rows of micro components 1 coming from two transferrers 33. The separator 31 includes two slide shutters that interchangeably reciprocate to separate the micro components 1 one by one from the transferrers 33. The micro components 1 will then move to an unshown working device 40 for a following process.

10 As shown in FIG. 6C, a microworkpiece separation unit 30 includes a separator 31 for separating micro components 1 coming along a transferrer 33. The separator 31 includes two plungers that are interchangeably activated to separate several micro components 1 (e.g., five ones as shown) each time from the transferrer 33.

15 As shown in FIG. 6D, a microworkpiece separation unit 30 includes a separator 31 for separating micro components 1 coming along a transferrer 33 and dividing them into two paths. The separator 31 includes a movable shutter that selectively opens one path at a time for a micro component 1 passing through so as to control the allocation of micro component 1.

20 The aforesaid components are tiny components for handling micro components 1 of micromachine. Therefore, they are made through micromachine technologies, such as microelectromechanical system (MEMS), lithography electrofoaming micromolding (LIGA) and some integrated circuit fabrication methods.

25 In conclusion, the invention provides a microworkpiece pickup mechanism for continuously supplying, orientating and separating micro components 1 so that the separated components oriented in a specific direction can be processed by a following working device for further assembly or fabrication.

The invention being thus described, it will be obvious that the same may be varied in

many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

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